

Applicant : GE Power Controls  
Berliner Platz 2-6  
24534 Neumünster  
Germany

Application date : 2002-06-17

Order number : 2021590.00-QUA/COM

Subject : Moulded-case circuit-breaker

Trade name : GE Power Controls

Type : Record Plus FDN 160 (LTM)

Arnhem, February 25, 2004

Manufacturer : GE Power Controls Polska, ul. Pilsudskiego 5,  
57-300 Kłodzko, Poland

Test requirements : EN 60947-2:1996 + C:1997-06 + A1:1997 + A11:1997  
IEC 60947-2: Edition 2.2, 2001-11

The performance of the circuit-breakers tested and the observations made during the tests have been recorded in the tables with test results.

Issued by : C.C. Burger 

Checked by : H.L. Schendstok 

- Enclosures:
- 8 test data sheets
  - 1 test circuit drawings
  - 1 oscillograms of circuit calibrations
  - 18 oscillograms of tests
  - 1 picture and 5 drawings of circuit breaker
  - 3 tripping curves

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**SUBJECT**

Moulded-case circuit-breaker Record Plus FDN 160 LTM (Line thermal magnetic protection)  
1 pole, with thermal-magnetic trip-unit.

Ratings assigned by the manufacturer

Rated operational current ( $I_e$ )	: 16 A - 160 A
Rated operational voltage ( $U_e$ )	: 240 Vac
Rated ultimate short-circuit breaking capacity ( $I_{cu}$ )	: 25 kA - 240 Vac
Rated service short-circuit breaking capacity ( $I_{cs}$ )	: $I_{cs} = I_{cu}$
Utilization category	: A

**Location of the tests**

The tests were carried out in the laboratories of GE Power Controls France at St-Quentin, France.

**Manufacturer's representatives during tests**

H. van der Spurt	GE Power Controls, Gent, Belgium
G. Jodehl	GE Power Controls, Neumünster, Germany
B. Czysch	GE Power Controls, Neumünster, Germany

**The tests were observed by:**

H.G.M. Kormelink	KEMA Quality B.V., Arnhem, The Netherlands
H.L. Schendstok	KEMA Quality B.V., Arnhem, The Netherlands

## General notes on tests:

The tests were carried out on the following samples:

number of poles	sample	rating & setting (A)	FDN 160 (LTM)				
			operational voltage (V) / test current (kA)				
			sequence I	sequence II	sequence III	sequence II + III	annex C or H
1	D03038-01	160 160				240 / 25	
1	D03038-02	160 63				240 / 25	
1	D03038-03	160 16				240 / 25	
1	D03038-04 (R)	160 160				240 / 25	

Notes: R: Connections reversed

The circuit-breaker was mounted in accordance with figure 1 of IEC 60947-2. The rigid shield and the metallic screen were combined into one single conductive metal plate.

During the O-tests the polyethylene sheet was mounted at a distance of 10 mm from the closing handle of the circuit-breaker.

The short circuit tests were carried out on circuit-breakers surrounded by a metallic screen.

The distances of the metallic screen to the circuit-breaker during the tests:

Back + front: 0 mm

Left + right: 5 mm

Top + bottom: 30 mm

The frequency during the tests was 50 Hz.

The short-circuit releases are dependent on ambient air temperature.

The manufacturer gives the following temperature/current data:

$k = [ ( 40 - t_{amb} ) \times 0,3 ] / 100 + 1$  for  $I_n = 16$  A up to and including 63 A.

$k = [ ( 40 - t_{amb} ) \times 0,5 ] / 100 + 1$  for  $I_n = 80$  A up to and including 160 A.

KEMA Quality B.V.	TABLE WITH TEST RESULTS				2021590.01-QUA/COM		Sheet 1
TEST SEQUENCE II + III							
<b>Object:</b> 1-pole moulded-case circuit-breaker Record Plus, Sample number FDN 160 / No. D03038-01: $U_e = 240 \text{ V}$ / $I_{th} = 160 \text{ A}$ / $I_{cs} = I_{cu} = 25 \text{ kA}$							
Osc	Current				Recovery Voltage		Remarks
No	peak	rms	duration	joule integral	peak	rms	
	kA	kA	ms	$\text{A}^2\text{s} \times 10^3$	V	V	
030522 -104	53,8	26,2	- - -	- - -	- - -	- - -	Current calibration 25 kA, 254 V, p.f. 0,24
030522 -105	10,83	- - -	7,55	286	459	255	Behaviour circuit-breaker O.K., sheet O.K., fine wire fuse O.K.
030522 -106	7,75	- - -	11,6	186,6	374	255	Behaviour circuit-breaker O.K. fine wire fuse O.K.
030522 -107	13,34	- - -	5,05	378	499	255	Behaviour circuit-breaker O.K. fine wire fuse O.K.

KEMA Quality B.V.	TEST SEQUENCE II + III	2021590.01-QUA/COM	Sheet 2
<b>Object:</b> 1-pole moulded-case circuit-breaker Record Plus, Sample number FDN 160 / No. D03038-01: $U_e = 240 \text{ V}$ / $I_{th} = 160 \text{ A}$ / $I_{cs} = I_{cu} = 25 \text{ kA}$			
<p>The circuit-breaker was not equipped with attachments.  The thermal setting and the magnetic setting are fixed.</p> <p>Before test 030522-105 the operation of the overload releases was verified at twice their current setting.  A correction of the current was made for the ambient temperature.  The circuit-breaker opened after: 180 s.  This time was within the value stated by the manufacturer.</p> <p>Test 030522-105: Rated service short-circuit breaking capacity, O test, prospective current 25 kA at 254 V,  Test 030522-106: Rated service short-circuit breaking capacity, CO test, prospective current 25 kA at 254 V,  Test 030522-107: Rated service short-circuit breaking capacity, CO test, prospective current 25 kA at 254 V.</p> <p>Verification of operational capability, 50 operations, load 160 A, 250 V, p.f. 0,8.</p> <p>After the verification of operational capability the verification of the dielectric withstand was carried out in the prescribed connections. The test voltage during these tests was 1000 V. (<math>2U_e</math> or minimum 1000 V)  There was no flash over or break down of the test voltage.</p> <p>The leakage current over the open contacts was measured at a voltage of <math>1,1U_e = 264 \text{ V}</math>.  The following value was measured: 0,82 mA.</p> <p>Verification of temperature-rise was carried out with rated current 160 A. All poles were connected by means of cables with a cross-section of 70 mm<sup>2</sup>. The following temperature rises were measured at the terminals:</p> <p>Line terminal: 65 K      Load terminal: 59 K</p> <p>Ambient temperature during test 22 °C.</p> <p>Verification of the overload releases:</p> <p>Immediately following the temperature-rise test the operation of the overload releases was verified at 1,45 times their current setting. The circuit-breaker opened after: 48 s.</p> <p>Thereafter, after cooling down, the operation of the overload releases was verified at 2,5 times their current setting. The circuit-breaker opened after: 62 s.</p> <p>These times were within the values stated by the manufacturer.</p>			

KEMA Quality B.V.	TABLE WITH TEST RESULTS				2021590.01-QUA/COM		Sheet 3
TEST SEQUENCE II + III							
<b>Object:</b> 1-pole moulded-case circuit-breaker Record Plus, Sample number FDN 160 / No. D03038-02: $U_e= 240 \text{ V}$ / $I_{th} = 63 \text{ A}$ / $I_{cs} = I_{cu} = 25 \text{ kA}$							
Osc	Current				Recovery Voltage		Remarks
No	peak	rms	duration	joule integral	peak	rms	
	kA	kA	ms	$\text{A}^2\text{s} \times 10^3$	V	V	
030522 -104	53,8	26,2	- - -	- - -	- - -	- - -	Current calibration 25 kA, 254 V, p.f. 0,24
030522 -108	13,03	- - -	7,5	418	532	256	Behaviour circuit-breaker O.K., sheet O.K., fine wire fuse O.K.
030522 -109	12,15	- - -	4,75	297	541	255	Behaviour circuit-breaker O.K. fine wire fuse O.K.
030522 -110	9,93	- - -	4,5	233	242	256	Behaviour circuit-breaker O.K. fine wire fuse O.K.

KEMA Quality B.V.	TEST SEQUENCE II + III	2021590.01-QUA/COM	Sheet 4
<b>Object:</b> 1-pole moulded-case circuit-breaker Record Plus, Sample number FDN 160 / No. D03038-02: $U_e = 240 \text{ V}$ / $I_{th} = 63 \text{ A}$ / $I_{cs} = I_{cu} = 25 \text{ kA}$			
<p>The circuit-breaker was not equipped with attachments.  The thermal setting and the magnetic setting are fixed.</p> <p>Before test 030522-108 verification of the overload releases was verified at twice their current setting.  A correction of the current was made for the ambient temperature.  The circuit-breaker opened after: 112 s.  This time was within the value stated by the manufacturer.</p> <p>Test 030522-108: Rated service short-circuit breaking capacity, O test, prospective current 25 kA at 254 V,  Test 030522-109: Rated service short-circuit breaking capacity, CO test, prospective current 25 kA at 254 V,  Test 030522-110: Rated service short-circuit breaking capacity, CO test, prospective current 25 kA at 254 V.</p> <p>Verification of operational capability, 75 operations, load 63 A, 250 V, p.f. 0,8.</p> <p>After the verification of operational capability the verification of the dielectric withstand was carried out in the prescribed connections. The test voltage during these tests was 1000 V. (<math>2U_e</math> or minimum 1000 V)  There was no flash over or break down of the test voltage.</p> <p>The leakage current over the open contacts was measured at a voltage of <math>1,1U_e = 264 \text{ V}</math>.  The following value was measured: 0,71 mA.</p> <p>Verification of temperature-rise was carried out with rated current 63 A. All poles were connected in series by means of cables with a cross-section of 16 mm<sup>2</sup>. The following temperature rises were measured at the terminals:</p> <p>Line terminals: 29 K    Load terminals: 36 K</p> <p>Ambient temperature during test 22 °C.</p> <p>Verification of the overload releases:</p> <p>Immediately following the temperature-rise test the operation of the overload releases was verified at 1,45 times their current setting. The circuit-breaker opened after: 120 s.</p> <p>Thereafter the operation of the overload releases was verified at 2,5 times their current setting.  The circuit-breaker opened after: 73 s.</p> <p>These times were within the values stated by the manufacturer.</p>			



KEMA Quality B.V.	TABLE WITH TEST RESULTS				2021590.01-QUA/COM		Sheet 5
TEST SEQUENCE II + III							
<b>Object:</b> 1-pole moulded-case circuit-breaker Record Plus, Sample number FDN 160 / No. D03038-03: $U_e=240\text{ V}$ / $I_{th}=16\text{ A}$ / $I_{cs}=I_{cu}=25\text{ kA}$							
Osc	Current				Recovery Voltage		Remarks
No	peak	rms	duration	joule integral	peak	rms	
	kA	kA	ms	$\text{A}^2\text{s} \times 10^3$	V	V	
030522 -104	53,8	26,2	- - -	- - -	- - -	- - -	Current calibration 25 kA, 254 V, p.f. 0,24
030522 -111	6,7	- - -	9,7	123,9	473	254	Behaviour circuit-breaker O.K., sheet O.K., fine wire fuse O.K.
030522 -112	7,12	- - -	9,55	116,1	493	255	Behaviour circuit-breaker O.K. fine wire fuse O.K.
030522 -113	6,98	- - -	9,4	112,1	511	255	Behaviour circuit-breaker O.K. fine wire fuse O.K.

KEMA Quality B.V.	TEST SEQUENCE II + III	2021590.01-QUA/COM	Sheet 6
<b>Object:</b> 1-pole moulded-case circuit-breaker Record Plus, Sample number FDN 160 / No. D03038-03: $U_e = 240 \text{ V}$ / $I_{th} = 16 \text{ A}$ / $I_{cs} = I_{cu} = 25 \text{ kA}$			
<p>The circuit-breaker was not equipped with attachments.  The thermal setting and the magnetic setting are fixed.</p> <p>Before test 030522-111 the operation of the overload releases was verified at twice their current setting.  A correction of the current was made for the ambient temperature.  The circuit-breaker opened after: 91 s.  This time was within the value stated by the manufacturer.</p> <p>Test 030522-111: Rated service short-circuit breaking capacity, O test, prospective current 25 kA at 254 V,  Test 030522-112: Rated service short-circuit breaking capacity, CO test, prospective current 25 kA at 254 V,  Test 030522-113: Rated service short-circuit breaking capacity, CO test, prospective current 25 kA at 254 V.</p> <p>Verification of operational capability was not performed on this sample.</p> <p>After the short circuit tests the verification of the dielectric withstand was carried out in the prescribed connections.  The test voltage during these tests was 1000 V. (<math>2U_e</math> or minimum 1000 V)  There was no flash over or break down of the test voltage.</p> <p>The leakage current over the open contacts was measured at a voltage of <math>1,1U_e = 264 \text{ V}</math>.  The following value was measured: <math>&lt; 0,01 \text{ mA}</math>.</p> <p>On this sample no verification of temperature rise was carried out.</p> <p>Verification of the overload releases:</p> <p>The operation of the overload releases was verified at 1,45 times their current setting.  The circuit-breaker opened after: 14 minutes.</p> <p>Thereafter the operation of the overload releases was verified at 2,5 times their current setting.  The circuit-breaker opened after: 45 s.</p> <p>These times were within the values stated by the manufacturer.</p>			

KEMA Quality B.V.	TABLE WITH TEST RESULTS				2021590.01-QUA/COM		Sheet 7
TEST SEQUENCE II + III							
<b>Object:</b> 1-pole moulded-case circuit-breaker Record Plus, Sample number FDN 160 / No. D03038-04: $U_e=240\text{ V}$ / $I_{th}=160\text{ A}$ / $I_{cs}=I_{cu}=25\text{ kA}$							
Osc	Current				Recovery Voltage		Remarks
No	peak	rms	duration	joule integral	peak	rms	
	kA	kA	ms	$A^2s \times 10^3$	V	V	
030522 -104	53,8	26,2	- - -	- - -	- - -	- - -	Current calibration 25 kA, 254 V, p.f. 0,24
030522 -114	11,53	- - -	9,3	328	472	254	Behaviour circuit-breaker O.K., sheet O.K., fine wire fuse O.K.
030522 -115	10,27	- - -	3,6	200	352	255	Behaviour circuit-breaker O.K. fine wire fuse O.K.
030522 -116	11,81	- - -	10,85	334	490	254	Behaviour circuit-breaker O.K. fine wire fuse O.K.

KEMA Quality B.V.	TEST SEQUENCE II + III	2021590.01-QUA/COM	Sheet 8
<b>Object:</b> 1-pole moulded-case circuit-breaker Record Plus, Sample number FDN 160 / No. D03038-04: $U_e = 240 \text{ V}$ / $I_{th} = 160 \text{ A}$ / $I_{cs} = I_{cu} = 25 \text{ kA}$			
<p>The circuit-breaker was not equipped with attachments.  The thermal setting and the magnetic setting are fixed.  The circuit breaker was reversed connected.</p> <p>Before test 030522-114 the operation of the overload releases was verified at twice their current setting.  A correction of the current was made for the ambient temperature.  The circuit-breaker opened after: 193 s.  This time was within the value stated by the manufacturer.</p> <p>Test 030522-114: Rated service short-circuit breaking capacity, O test, prospective current 25 kA at 254 V,  Test 030522-115: Rated service short-circuit breaking capacity, CO test, prospective current 25 kA at 254 V,  Test 030522-116: Rated service short-circuit breaking capacity, CO test, prospective current 25 kA at 254 V.</p> <p>Verification of operational capability, 50 operations, load 160 A, 250 V, p.f. 0,8.</p> <p>After the verification of operational capability the verification of the dielectric withstand was carried out in the prescribed connections. The test voltage during these tests was 1000 V. (<math>2U_e</math> or minimum 1000 V)  There was no flash over or break down of the test voltage.</p> <p>The leakage current over the open contacts was measured at a voltage of <math>1,1U_e = 264 \text{ V}</math>.  The following value was measured: 1,02 mA.</p> <p>Verification of temperature-rise was carried out with rated current 160 A. All poles were connected in series by means of cables with a cross-section of 70 mm<sup>2</sup>. The following temperature rises were measured at the terminals:</p> <p>Line terminals: 61 K    Load terminals: 51 K</p> <p>Ambient temperature during test 22 °C.</p> <p>Verification of the overload releases:</p> <p>Immediately following the temperature-rise test the operation of the overload releases was verified at 1,45 times their current setting. The circuit-breaker opened after: 90 s.</p> <p>Thereafter the operation of the overload releases was verified at 2,5 times their current setting.  The circuit-breaker opened after: 84 s.</p> <p>These times were within the values stated by the manufacturer.</p>			

GE POWER CONTROLS FRANCE

Test report N°: 2021590.01-QUA/COM  
Test circuit diagram

Type test according to: IEC 60947-2

Type: Record Plus D-Frame

## Schéma de la plate-forme 100 MVA Diagram of the test platform 100 MVA 1-Pole Tests

- ALT: Alternateur 100 MVA  
Alternator 100 MVA  
DP: Disjoncteurs de protection  
Main circuit-breakers  
TR : Transformateur de charge  
Load transformer  
EN : Enclencheur  
Making switch  
EA : Appareil en essai  
Circuit-breaker under test  
V&I Enregistrements tension et courant  
Recording voltage and current elements  
R: résistances réglables  
Adjustable resistors  
L: Inductances réglables  
Adjustable reactors  
F: Dispositif de détection du courant de défaut  
Device for the detection of a fault current  
R1: Résistance limitant le courant dans le dispositif F  
Resistor limiting the current in the device F

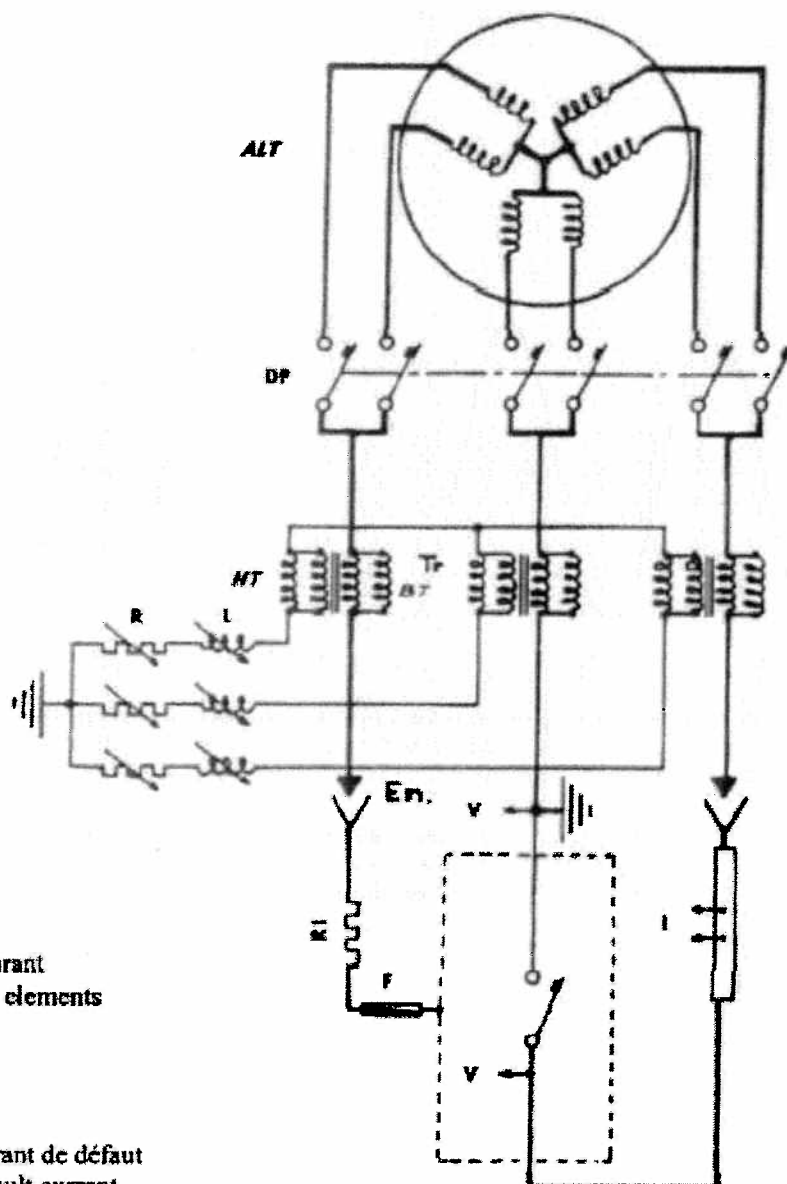


Diagram of the test circuit for the verification of short-circuit withstand and making capacities of one-pole equipment.

## Oscillogram 1: Calibration

Apparatus :

Test No : 030522\_104

Date : May 22, 2003

Type of test : Current calibration

Commentary :

Assigned Voltage : 240 V

Test Voltage : 254 V

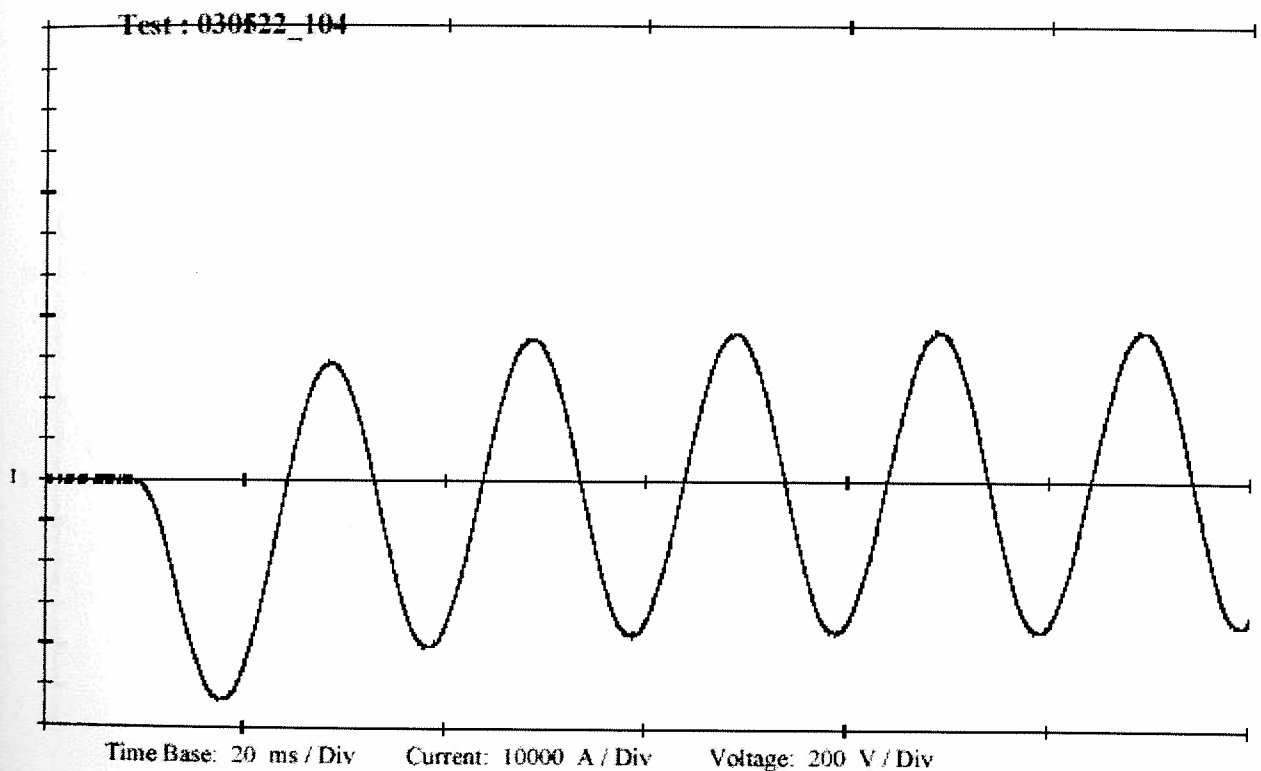
Frequency : 50 Hz

Test Current : 25000 A

Power Factor : 0.25

Test Circuit No : 3.1

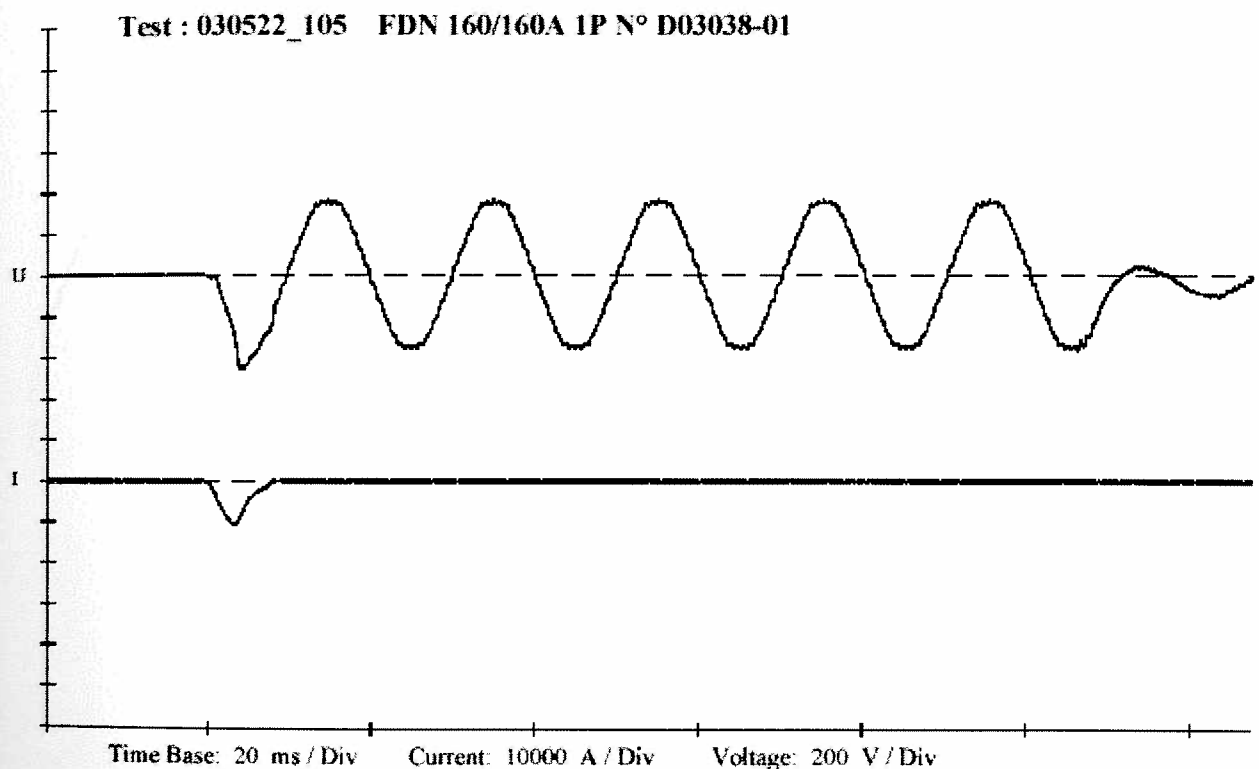
File : D:\FD 1 pole\03-05-22A-D03038\030522-104



Measure at 2 ms	I1 :	26037 A rms	-0.8 % de la moyenne à 2 ms
	I2 :	26438 A rms	0.7 % de la moyenne à 2 ms
	I3 :	26249 A rms	0 % de la moyenne à 2 ms
Average at 2 ms	:	26241 A rms	4.9 % de I Assigné
Peak Value	:	53750 A peak	
Power Factor	:	0.24	

## Oscillogram 2: O operation sample 01

Apparatus : FDN 160/160A 1P N° D03038-01  
 Test No : 030522\_105  
 Type of test : Sequence II = sequence III  
 Commentary : O operation  
 Assigned Voltage : 240 V  
 Test Voltage : 254 V  
 Frequency : 50 Hz  
 Test Current : 25000 A  
 Power Factor : 0.25  
 Test Circuit No : 3.1  
 File : D:\FD 1 pole\03-05-22A-D03038\030522-105



Calculation between: 29.95 ms et 37.5 ms - Time 7.55 ms

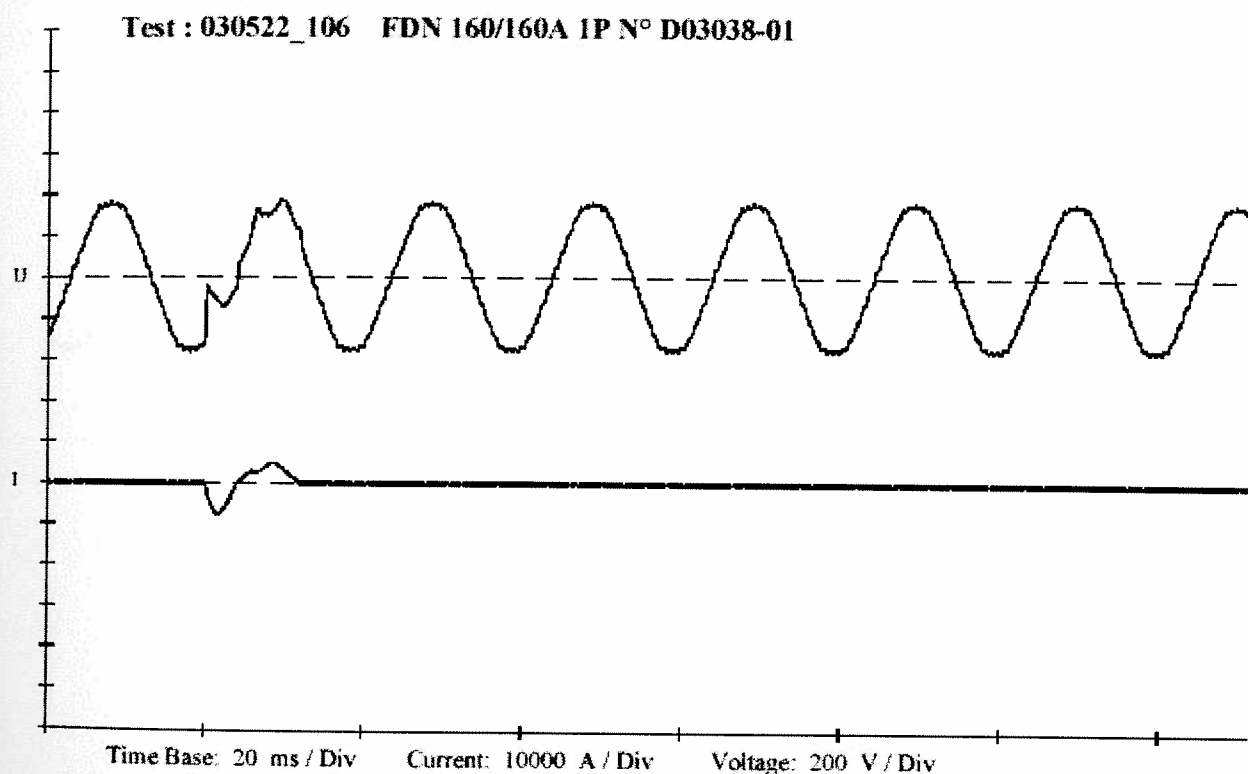
	Phase I	Units
U Max	459	V
I Max	10.83	kA
UI Max	4.44	10 <sup>6</sup> VA
SUI dt	11.27	kJ
Si2 dt	286	kA <sup>2</sup> s
U recovery	255	V
Ur / U Assigned	106.4	%

### Observations :

Fuse Not Melted  
 Manifestations : Moderate  
 Result OK

## Oscillogram 3: 1<sup>st</sup> CO operation sample 01

Apparatus : FDN 160/160A 1P N° D03038-01  
 Test No : 030522\_106 Date : May 22, 2003  
 Type of test : Sequence II = sequence III  
 Commentary : 1st CO operation  
 Assigned Voltage : 240 V Test Voltage : 254 V Frequency : 50 Hz  
 Test Current : 25000 A Power Factor : 0.25 Test Circuit No : 3.1  
 File : D:\FD 1 pole\03-05-22A-D03038\030522-106



Calculation between: 29.95 ms. et 41.55 ms. Time 11.6 ms

	Phase I	Units
U Max	374	V
I Max	7.75	kA
UI Max	1.705	10 <sup>6</sup> VA
SUI dt	8.56	kJ
Si2 dt	186.6	kA <sup>2</sup> s
U recovery	255	V
Ur / U Assigned	106.4	%

### Observations :

Fuse Not Melted  
 Manifestations : Moderate  
 Result OK



## Oscillogram 4: 2<sup>nd</sup> CO operation sample 01

Apparatus : FDN 160/160A 1P N° D03038-01

Test No : 030522\_107

Date : May 22, 2003

Type of test : Sequence II = sequence III

Commentary : 2nd CO operation

Assigned Voltage : 240 V

Test Voltage : 254 V

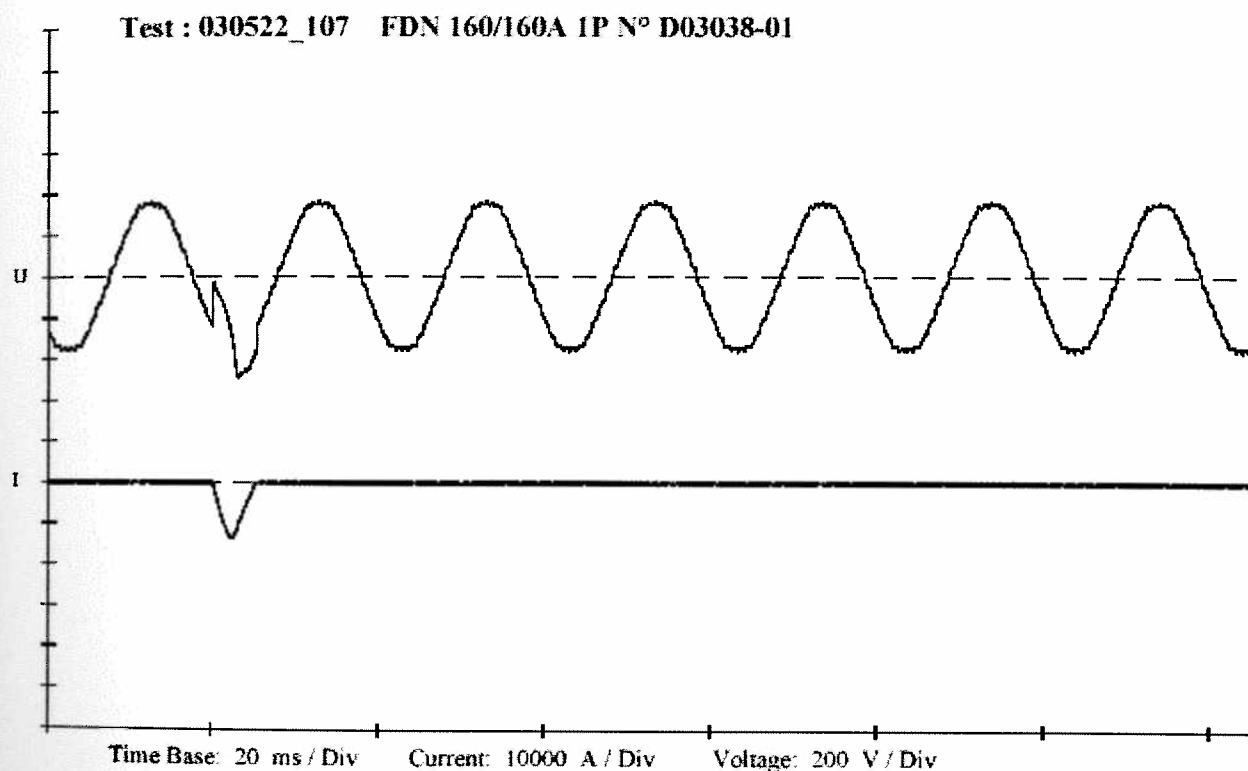
Frequency : 50 Hz

Test Current : 25000 A

Power Factor : 0.25

Test Circuit No : 3.1

File :



Calculation between: 29.95 ms et 35 ms, Time 5.05 ms

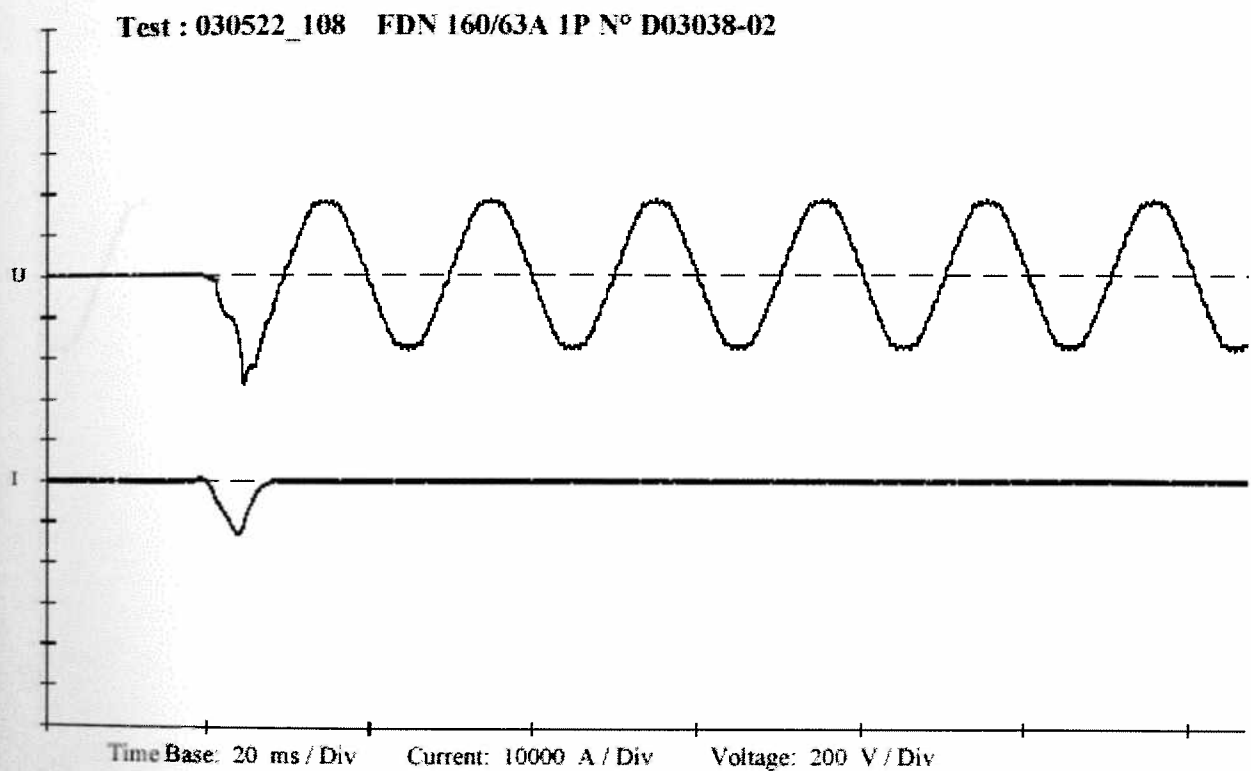
	Phase I	Units
U Max	499	V
I Max	13.34	kA
UI Max	5.55	10 <sup>6</sup> VA
SUI dt	12.04	kJ
Si2 dt	378	kA <sup>2</sup> s
U recovery	255	V
Ur / U Assigned	106.3	%

### Observations :

Fuse Not Melted  
Manifestations : Moderate  
Result OK

## Oscillogram 5: O operation sample 02

Apparatus : FDN 160/63A 1P N° D03038-02  
 Test No : 030522\_108  
 Type of test : Sequence II = sequence III  
 Commentary : O operation  
 Assigned Voltage : 240 V  
 Test Current : 25000 A  
 Test Voltage : 254 V  
 Power Factor : 0.25  
 Date : May 22, 2003  
 Frequency : 50 Hz  
 Test Circuit No : 3.1  
 File :



Calculation between: 29.95 ms et 37.45 ms, Time 7.5 ms

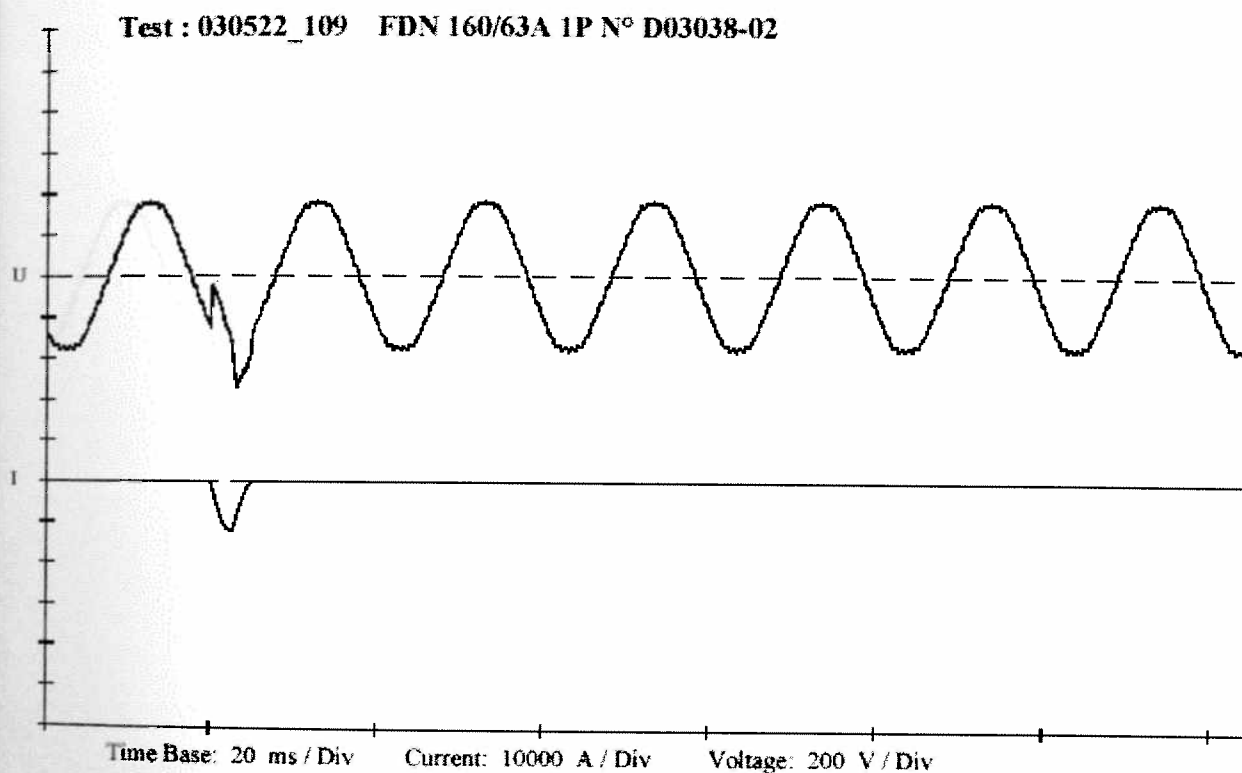
	Phase I	Units
U Max	532	V
I Max	13.03	kA
UI Max	5.84	10 <sup>6</sup> VA
SUI dt	13.77	kJ
Si2 dt	418	kA <sup>2</sup> s
U recovery	256	V
Ur / U Assigned	106.5	%

### Observations :

Fuse Not Melted  
 Manifestations : Moderate  
 Result OK

## Oscillogram 6: 1<sup>st</sup> CO operation sample 02

Apparatus : FDN 160/63A 1P N° D03038-02  
 Test No : 030522\_109  
 Type of test : Sequence II = sequence III  
 Commentary : 1<sup>st</sup> CO operation  
 Assigned Voltage : 240 V  
 Test Voltage : 254 V  
 Frequency : 50 Hz  
 Test Current : 25000 A  
 Power Factor : 0.25  
 Test Circuit No : 3.1  
 Date : May 22, 2003  
 File :



Calculation between: 29.95 ms et 34.7 ms. Time 4.75 ms

	Phase I	Units
U Max	541	V
I Max	12.15	kA
UI Max	5.28	10 <sup>6</sup> VA
SUI dt	10.4	kJ
Si2 dt	297	kA <sup>2</sup> s
U recovery	255	V
Ur / U Assigned	106.4	%

### Observations :

Fuse Not Melted  
 Manifestations : Moderate  
 Result OK

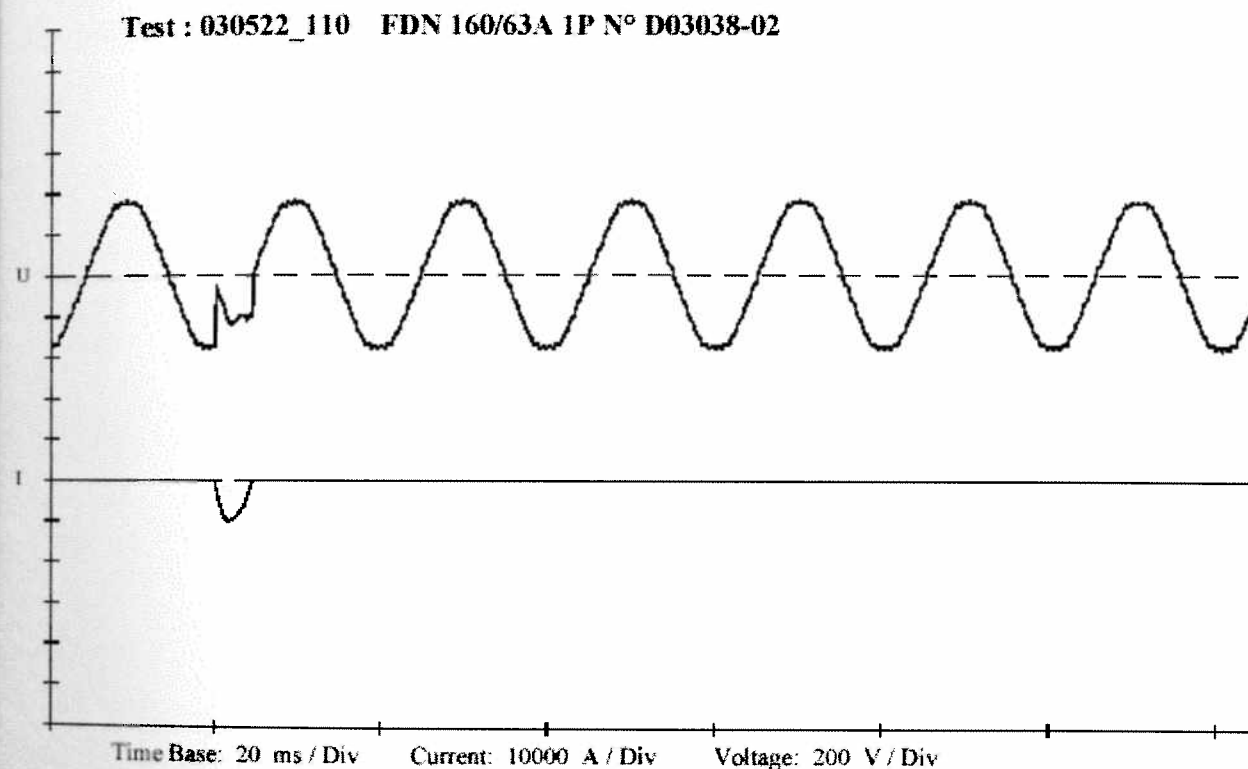
## Oscillogram 7: 2<sup>nd</sup> CO operation sample 02

Apparatus : FDN 160/63A 1P N° D03038-02  
 Test No : 030522\_110  
 Type of test : Sequence II = sequence III  
 Commentary : 2nd CO operation  
 Assigned Voltage : 240 V  
 Test Current : 25000 A  
 File : D:\FD 1 pole\03-05-22A-D03038\030522-110

Date : May 22, 2003

Frequency : 50 Hz

Test Circuit No : 3.1



Calculation between: 29.95 ms. et 34.45 ms. Time 4.5 ms

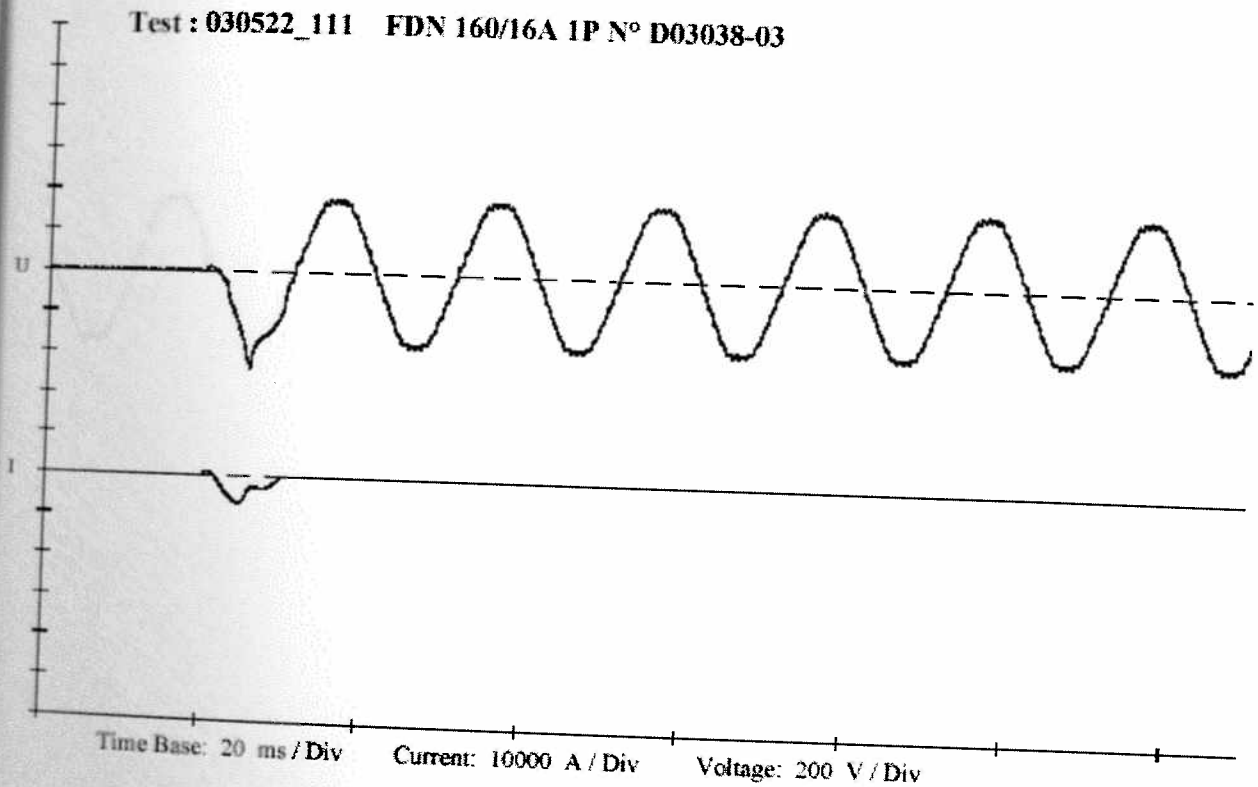
	Phase I	Units
U Max	242	V
I Max	9.93	kA
UI Max	2.38	10 <sup>6</sup> VA
SUI dt	5.87	kJ
Si2 dt	233	kA <sup>2</sup> s
U recovery	255	V
Ur / U Assigned	106.4	%

### Observations :

Fuse Not Melted  
 Manifestations : Moderate  
 Result OK

## Oscillogram 8: O operation sample 03

Apparatus : FDN 160/16A 1P N° D03038-03  
 Test No : 030522\_111  
 Type of test : Sequence II = sequence III  
 Date : May 22, 2003  
 Commentary : O operation  
 Assigned Voltage : 240 V  
 Test Voltage : 254 V  
 Frequency : 50 Hz  
 Test Current : 25000 A  
 Power Factor : 0.25  
 Test Circuit No : 3.1  
 File : D:\FD 1 pole\03-05-22A-D03038\030522-111



Calculation between: 29.95 ms et 39.65 ms. Time 9.7 ms

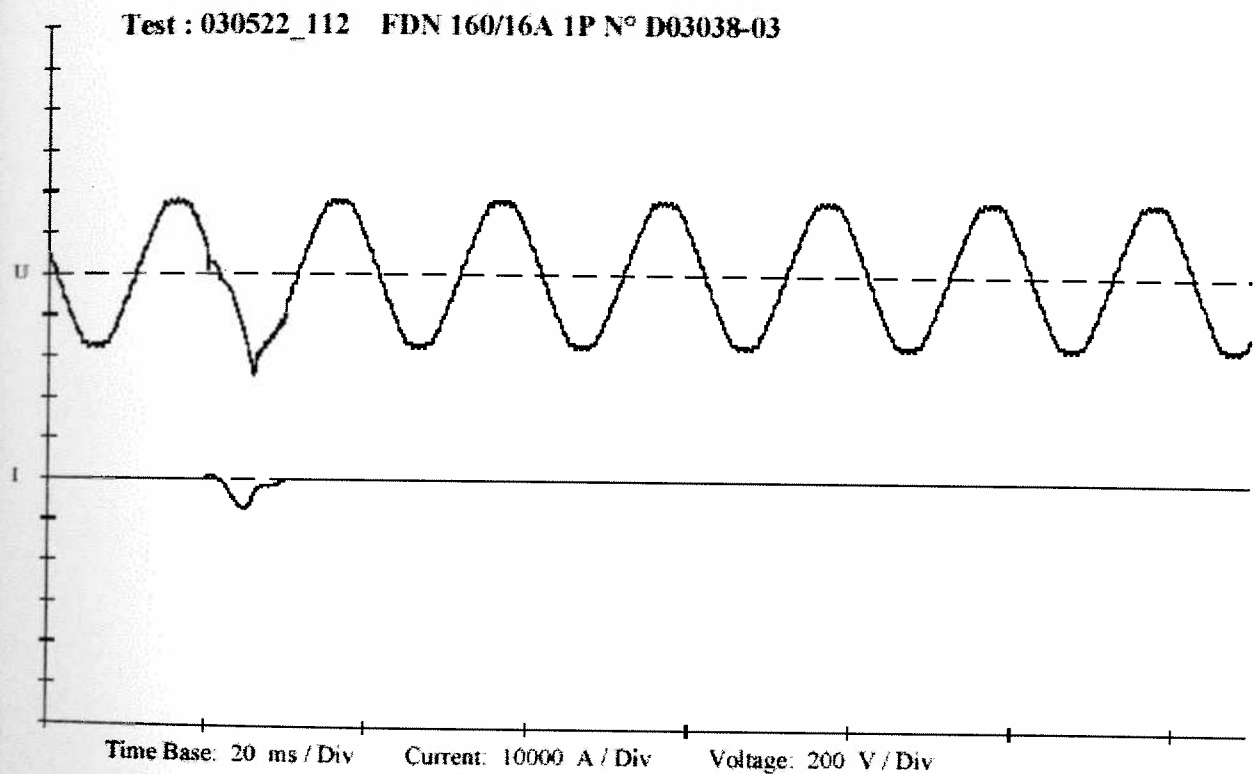
	Phase 1	Units
U Max	473	V
I Max	6.7	kA
UI Max	2.46	10 <sup>6</sup> VA
SUI dt	7.99	kJ
Si2 dt	123.9	kA²s
U recovery	254	V
Ur / U Assigned	105.9	%

### Observations :

Fuse Not Melted  
 Manifestations : Moderate  
 Result OK

## Oscillogram 9: 1<sup>st</sup> CO operation sample 03

Apparatus : FDN 160/16A 1P N° D03038-03  
 Test No : 030522\_112  
 Type of test : Sequence II = sequence III  
 Commentary : 1st CO operation  
 Assigned Voltage : 240 V  
 Test Voltage : 254 V  
 Frequency : 50 Hz  
 Test Current : 25000 A  
 Power Factor : 0.25  
 Test Circuit No : 3.1  
 File : D:\FD 1 pole\03-05-22A-D03038\030522-112



Calculation between: 29.95 ms et 39.5 ms, Time 9.55 ms

	Phase I	Units
U Max	493	V
I Max	7.12	kA
UI Max	2.59	10 <sup>6</sup> VA
SUI dt	7.06	kJ
Si2 dt	116.1	kA <sup>2</sup> s
U recovery	255	V
Ur / U Assigned	106.1	%

### Observations :

Fuse Not Melted  
 Manifestations : Moderate  
 Result OK

## Oscillogram 10: 2<sup>nd</sup> CO operation sample 03

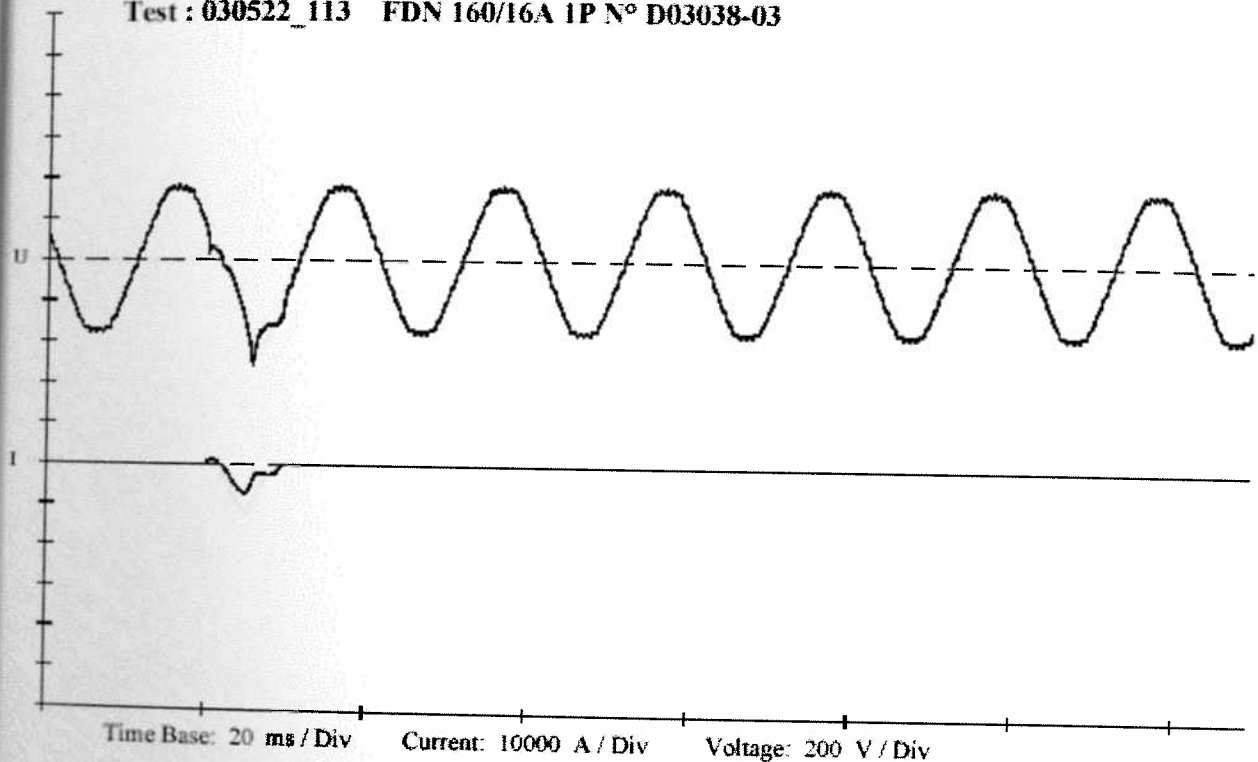
Apparatus : FDN 160/16A 1P N° D03038-03  
 Test No : 030522\_113  
 Type of test : Sequence II = sequence III  
 Commentary : 2nd CO operation  
 Assigned Voltage : 240 V  
 Test Current : 25000 A  
 File : D:\FD 1 pole\03-05-22A-D03038\030522-113

Date : May 22, 2003

Frequency : 50 Hz

Test Circuit No : 3.1

Test : 030522\_113 FDN 160/16A 1P N° D03038-03



Calculation between: 29.95 ms et 39.35 ms, Time 9.4 ms

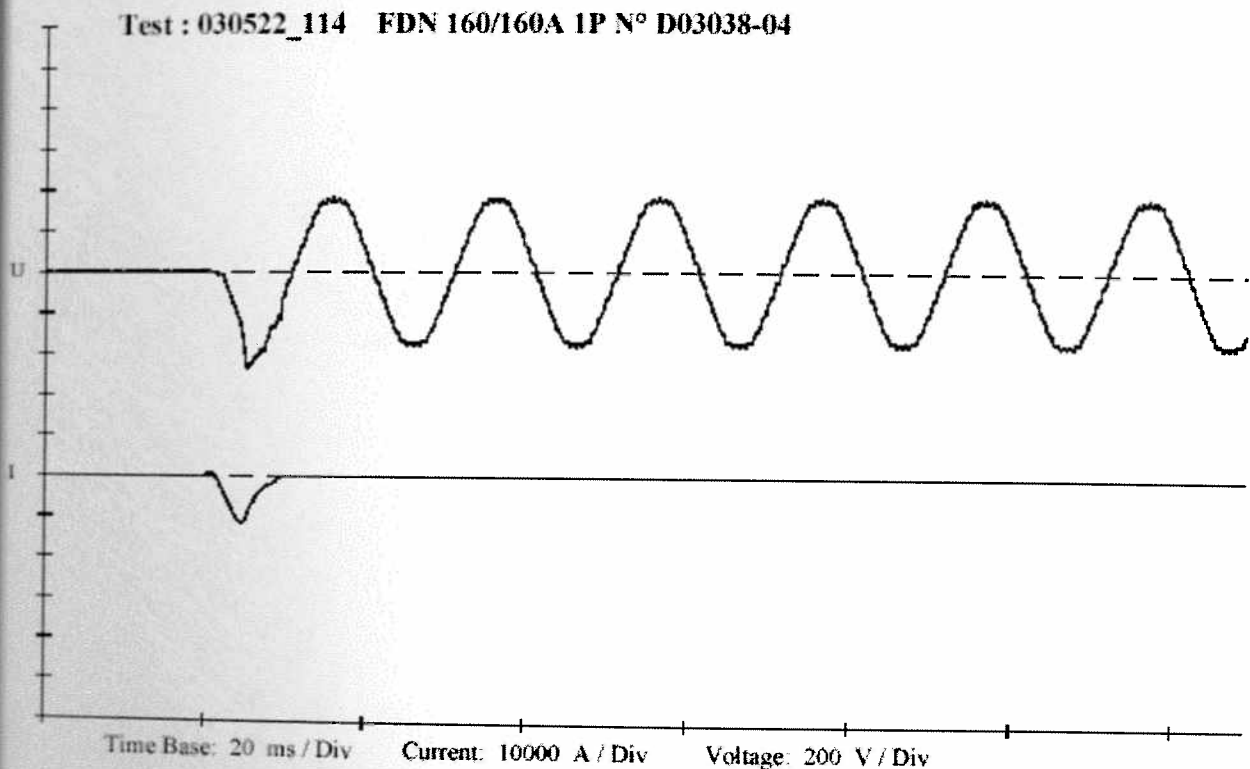
	Phase I	Units
U Max	511	V
I Max	6.98	kA
UI Max	2.62	10 <sup>6</sup> VA
SUI dt	7.15	kJ
Si2 dt	112.1	kA <sup>2</sup> s
U recovery	255	V
Ur / U Assigned	106.1	%

### Observations :

Fuse Not Melted  
 Manifestations : Moderate  
 Result OK

## Oscillogram 11: O operation sample 04

Apparatus : FDN 160/160A 1P N° D03038-04  
 Test No : 030522\_114  
 Type of test : Sequence II = sequence III , reverse  
 Commentary : O operation  
 Assigned Voltage : 240 V  
 Test Voltage : 254 V  
 Frequency : 50 Hz  
 Test Current : 25000 A  
 Power Factor : 0.25  
 Test Circuit No : 3.1  
 File : D:\FD 1 pole\03-05-22A-D03038\030522-114



Calculation between: 29.95 ms et 39.25 ms , Time 9.3 ms

	Phase I	Units
U Max	472	V
I Max	11.53	kA
UI Max	4.78	10 <sup>6</sup> VA
SUIdt	12.22	kJ
Si2dt	328	kA <sup>2</sup> s
U recovery	254	V
Ur / U Assigned	105.9	%

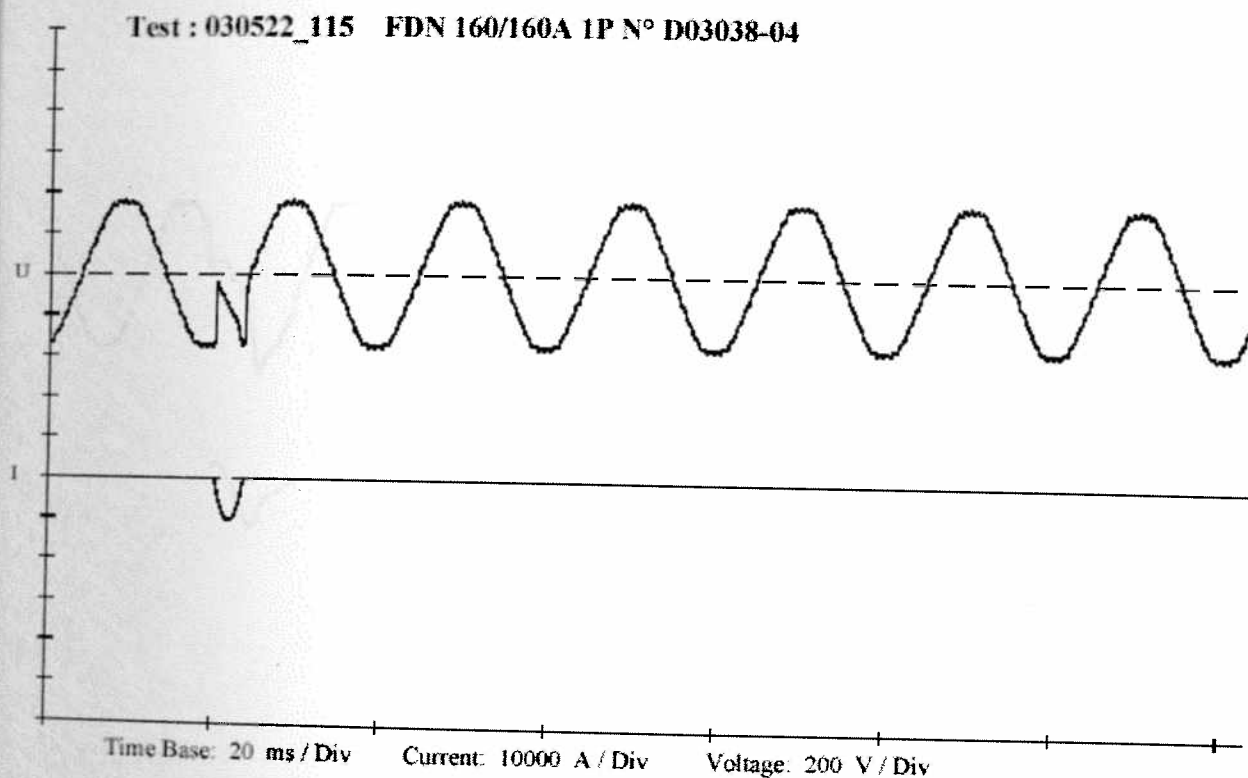
### Observations :

Fuse Not Melted  
 Manifestations : Moderate  
 Result OK



## Oscillogram 12: 1<sup>st</sup> CO operation sample 04

Apparatus : FDN 160/160A 1P N° D03038-04  
 Test No : 030522\_115  
 Type of test : Sequence II = sequence III ,reverse  
 Commentary : 1st CO operation  
 Assigned Voltage : 240 V  
 Test Current : 25000 A  
 File : D:\FD 1 pole\03-05-22A-D03038\030522-115  
 Date : May 22, 2003  
 Frequency : 50 Hz  
 Test Circuit No : 3.1



Calculation between: 29.95 ms et 33.55 ms. Time 3.6 ms

	Phase I	Units
U Max	352	V
I Max	10.27	kA
UI Max	2.08	10 <sup>6</sup> VA
SUI dt	4.6	kJ
Si2 dt	200	kA <sup>2</sup> s
U recovery	255	V
Ur / U Assigned	106.1	%

### Observations :

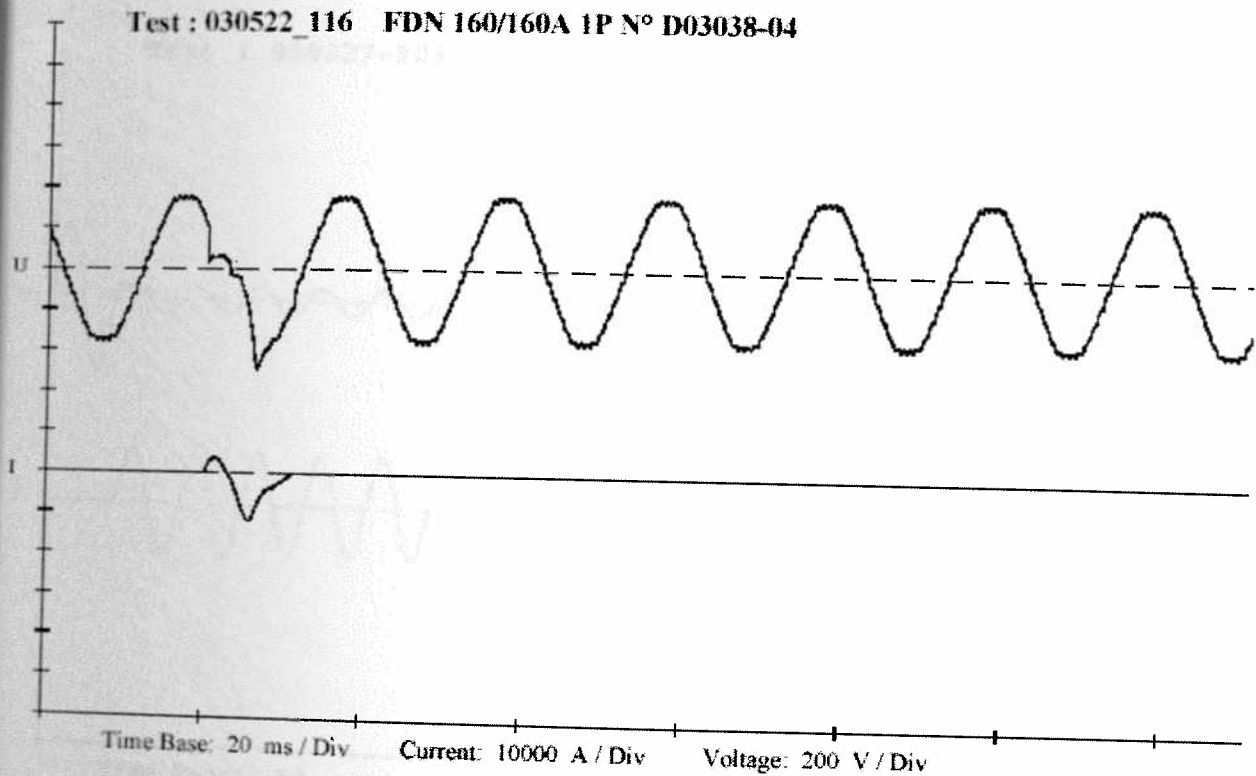
Fuse Not Melted  
 Manifestations : Moderate  
 Result OK

## Oscillogram 13: 2<sup>nd</sup> CO operation sample 04

Apparatus : FDN 160/160A 1P N° D03038-04  
 Test No : 030522\_116  
 Type of test : Sequence II = sequence III ,reverse  
 Commentary : 2nd CO operation  
 Assigned Voltage : 240 V  
 Test Current : 25000 A  
 File : D:\FD 1 pole\03-05-22A-D03038\030522-116

Date : May 22, 2003

Frequency : 50 Hz  
 Test Circuit No : 3.1



Calculation between: 29.95 ms et 40.8 ms - Time 10.85 ms

	Phase I	Units
U Max	490	V
I Max	11.81	kA
UI Max	4.92	10 <sup>-6</sup> VA
SUI dt	12.35	kJ
Si2 dt	334	kA <sup>2</sup> s
U recovery	254	V
Ur / U Assigned	106	%

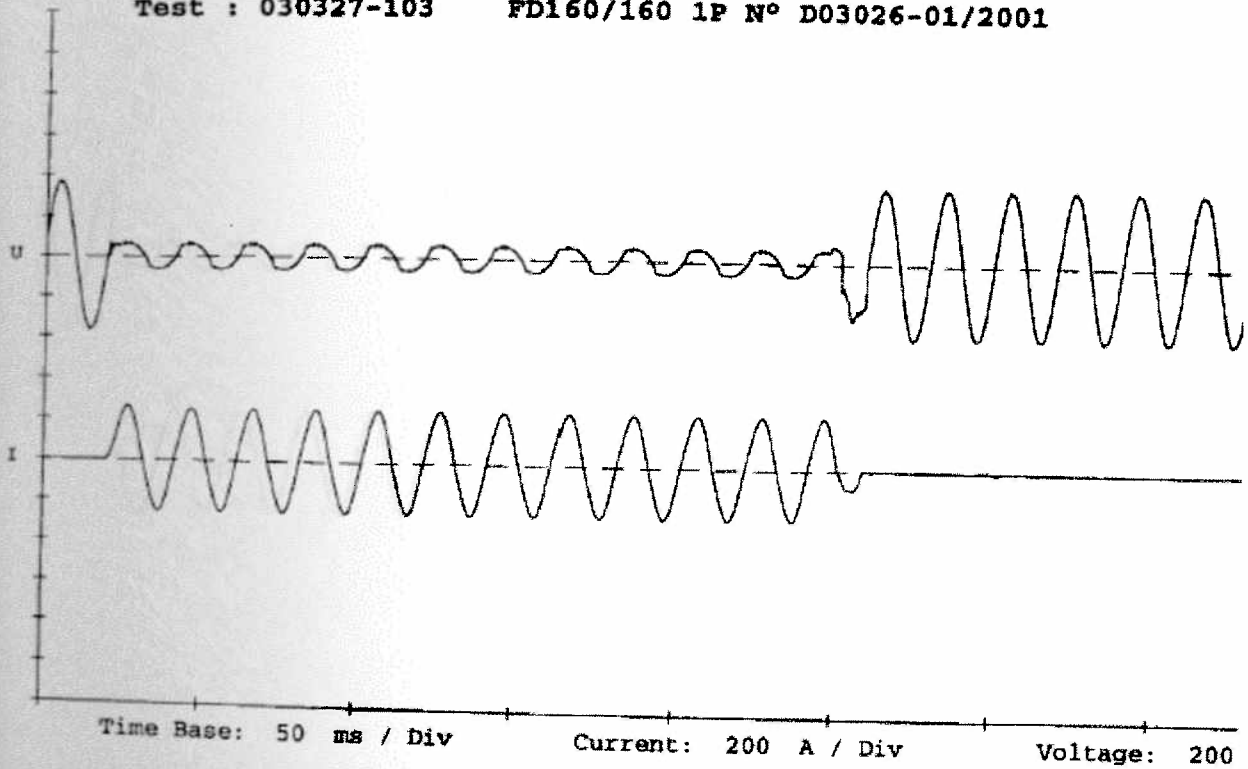
### Observations :

Fuse Not Melted  
 Manifestations : Moderate  
 Result OK

Oscillogram 14: 1<sup>st</sup> CO operational capability sample 01

Apparatus : FD160/160 1P N° D03026-01/2001  
 Test No : 030327-103  
 Type of test : Electrical Operation  
 Commentary : after Ics 25kA/240V  
 1st CO Operation  
 Assigned Voltage : 240 V Test Voltage : 250 V  
 Test Current : 160 A Power Factor : 0.8  
 File : E:\FD160\_1P\030522c\y030521-303

Test : 030327-103 FD160/160 1P N° D03026-01/2001



Calculation between: 45.2 ms at 285.5 ms . Time 238.6 ms

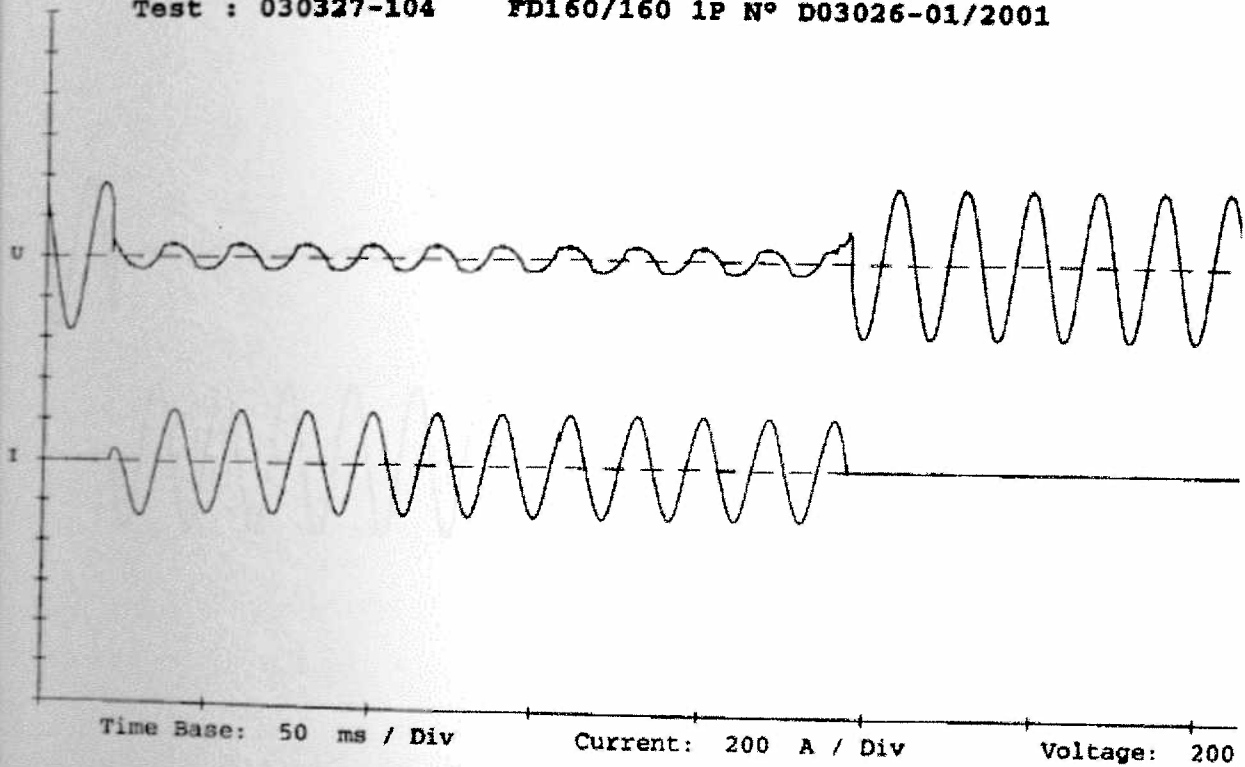
	Phase 1	Units
U Max	283	V
I Max	263	A
UI Max	24.8	kVA
SUI dt	1.981	kJ
Si2 dt	7.07	kA <sup>2</sup> s
U recovery	260	V
Ur / U Assigned	108.3	%
I rms 20 ms	174.6	A rms

Observations :  
 Result OK

Oscillogram 15: 50<sup>th</sup> CO operational capability sample 01

Apparatus : FD160/160 1P N° D03026-01/2001  
 Test No : 030327-104  
 Type of test : Electrical Operation  
 Commentary : after Ics 25kA/240V  
 50th CO Operation  
 Assigned Voltage : 240 V Test Voltage : 250 V  
 Test Current : 160 A Power Factor : 0.8  
 File : E:\FD160\_1P\030522c\y030521-304

Test : 030327-104 FD160/160 1P N° D03026-01/2001



Calculation between: 45.35 ms et 269.35 ms . Time 224 ms

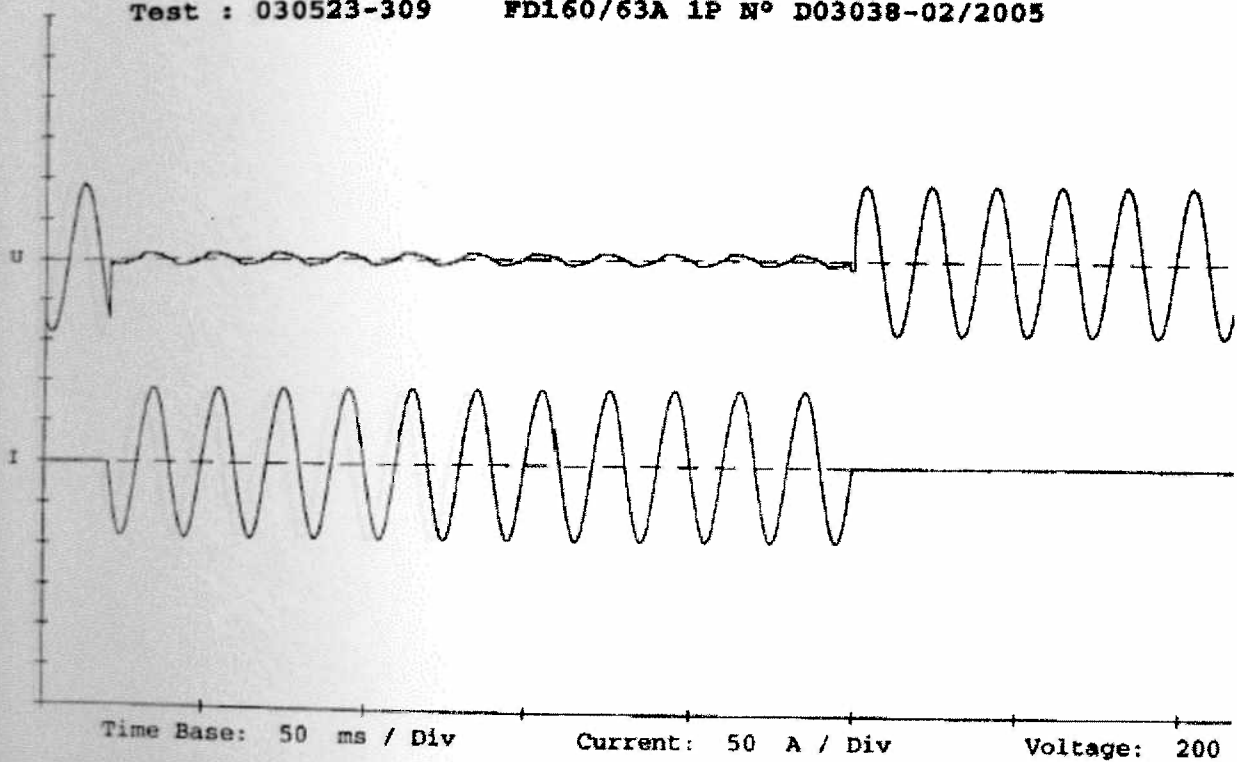
	Phase 1	Units
U Max	157.6	V
I Max	273	A
UI Max	24	kVA
SUI dt	1.782	kJ
Si2 dt	6.67	kA²s
U recovery	258	V
Ur / U Assigned	107.7	%
I rms 20 ms	173.5	A rms

Observations :  
 Result OK

Oscillogram 16: 1<sup>st</sup> CO operational capability sample 02

Apparatus : FD160/63A 1P N° D03038-02/2005  
 Test No : 030523-309  
 Type of test : Electrical Operation  
 Commentary : after Ics 25kA/240V  
 1st CO Operation  
 Assigned Voltage : 240 V Test Voltage : 250 V  
 Test Current : 63 A Power Factor : 0.8  
 File : E:\FD160\_1P\030522c\y030522-309

Test : 030523-309 FD160/63A 1P N° D03038-02/2005



Calculation between: 40.05 ms at 268.9 ms , Time 228.85 ms

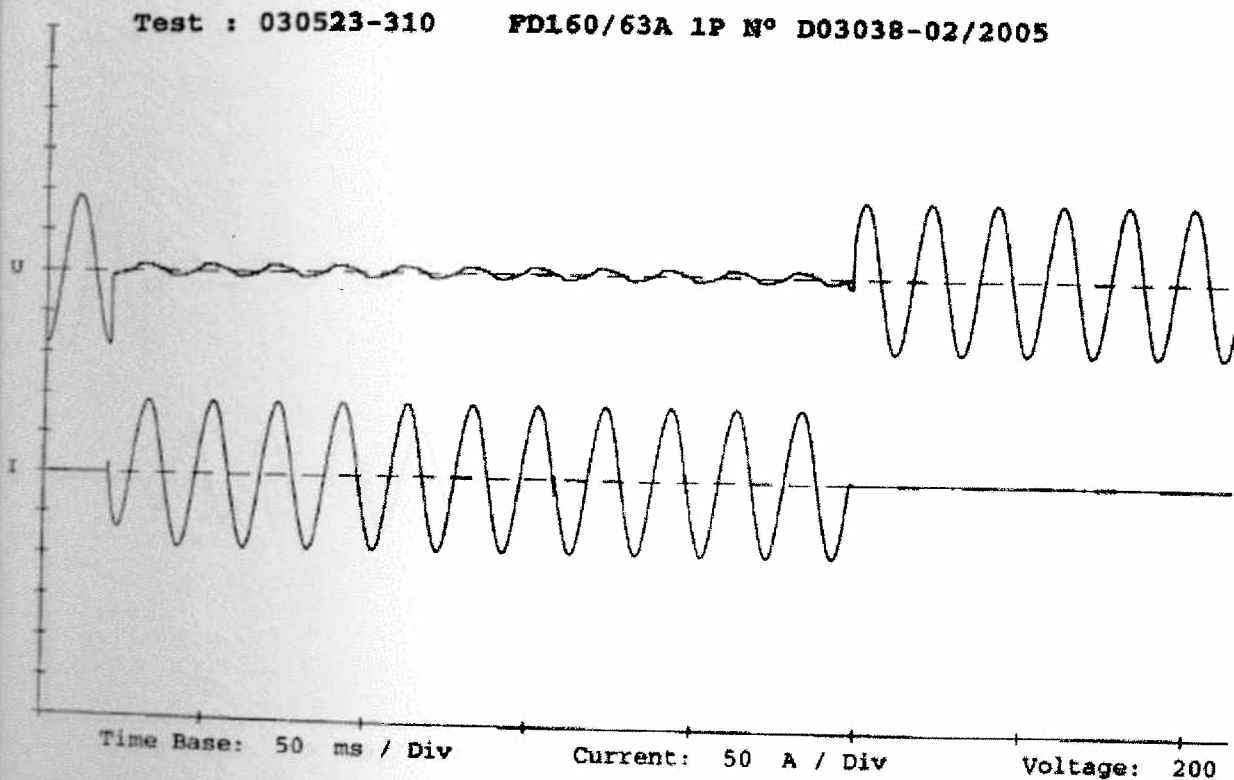
	Phase 1	Units
U Max	44.1	V
I Max	90.9	A
UI Max	3.2	kVA
SUI dt	276	J
SI2 dt	932	A's
U recovery	258	V
Ur / U Assigned	107.5	%
I rms 20 ms	63.8	A rms

Observations :

Result OK  
 Power Factor = 0.79

Oscillogram 17: 75<sup>th</sup> CO operational capability sample 02

Apparatus : FD160/63A 1P N° D03038-02/2005  
 Test No : 030523-310  
 Type of test : Electrical Operation  
 Commentary : after Ics 25kA/240V  
 75<sup>th</sup> CO Operation  
 Assigned Voltage : 240 V Test Voltage : 250 V  
 Test Current : 63 A Power Factor : 0.8  
 File : E:\FD160\_1P\030522c\y030522-310



Calculation between: 42.55 ms et 269.2 ms , Time 226.65 ms

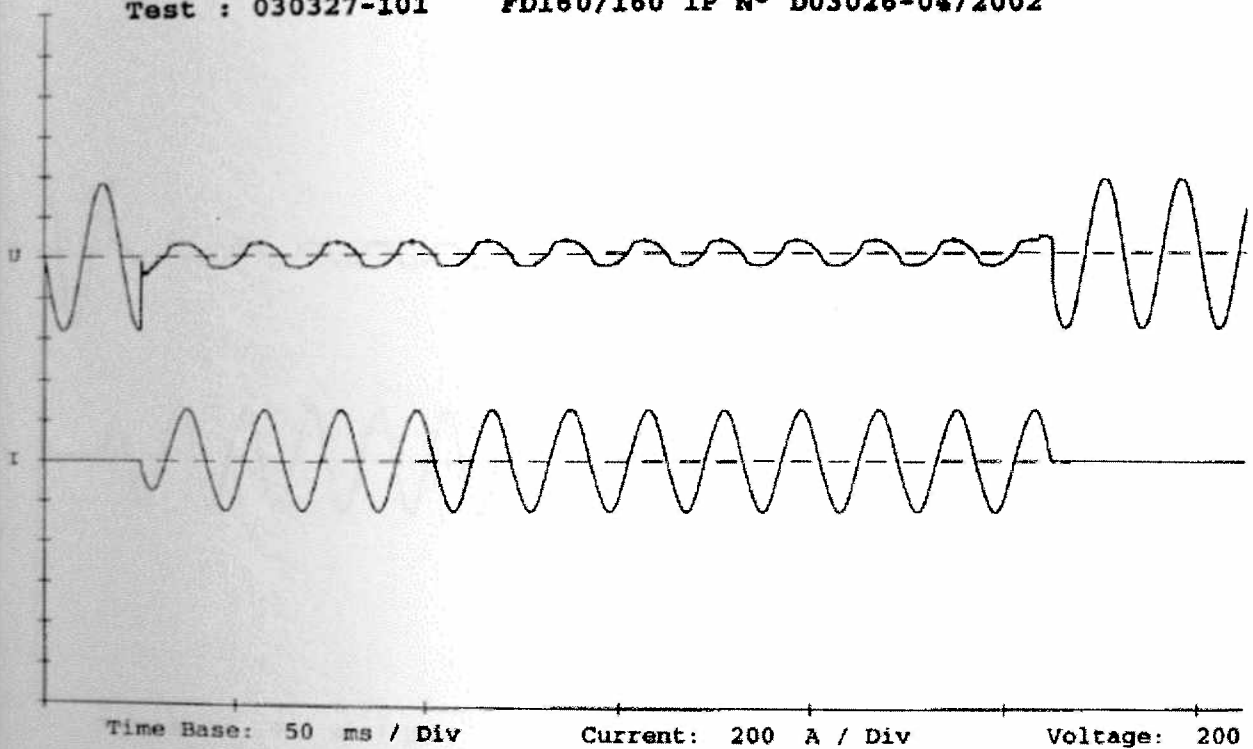
	Phase 1	Units
U Max	53	V
I Max	90.9	A
UI Max	3.19	kVA
SUI dt	268	J
Si2 dt	904	A²s
U recovery	258	V
Ur / U Assigned	107.4	%
I rms 20 ms	63.5	A rms

Observations :  
 Result OK

Oscillogram 18: 1<sup>st</sup> CO operational capability sample 04

Apparatus : FD160/160 1P N° D03026-04/2002  
 Test No : 030327-101  
 Type of test : Electrical Operation  
 Commentary : after Ics 25kA/240V  
 1st CO Operation  
 Assigned Voltage : 240 V Test Voltage : 250 V  
 Test Current : 160 A Power Factor : 0.8  
 File : E:\FD160\_1P\030522c\y030521-301

Test : 030327-101 FD160/160 1P N° D03026-04/2002



Calculation between: 37.65 ms et 209.8 ms , Time 172.15 ms

	Phase 1	Units
U Max	362	V
I Max	256	A
UI Max	16.95	kVA
SUI dt	1.289	kJ
Si2 dt	4.87	kA <sup>2</sup> s
U recovery	47.6	V
Ur / U Assigned	19.8	%
I rms 20 ms	172.8	A rms

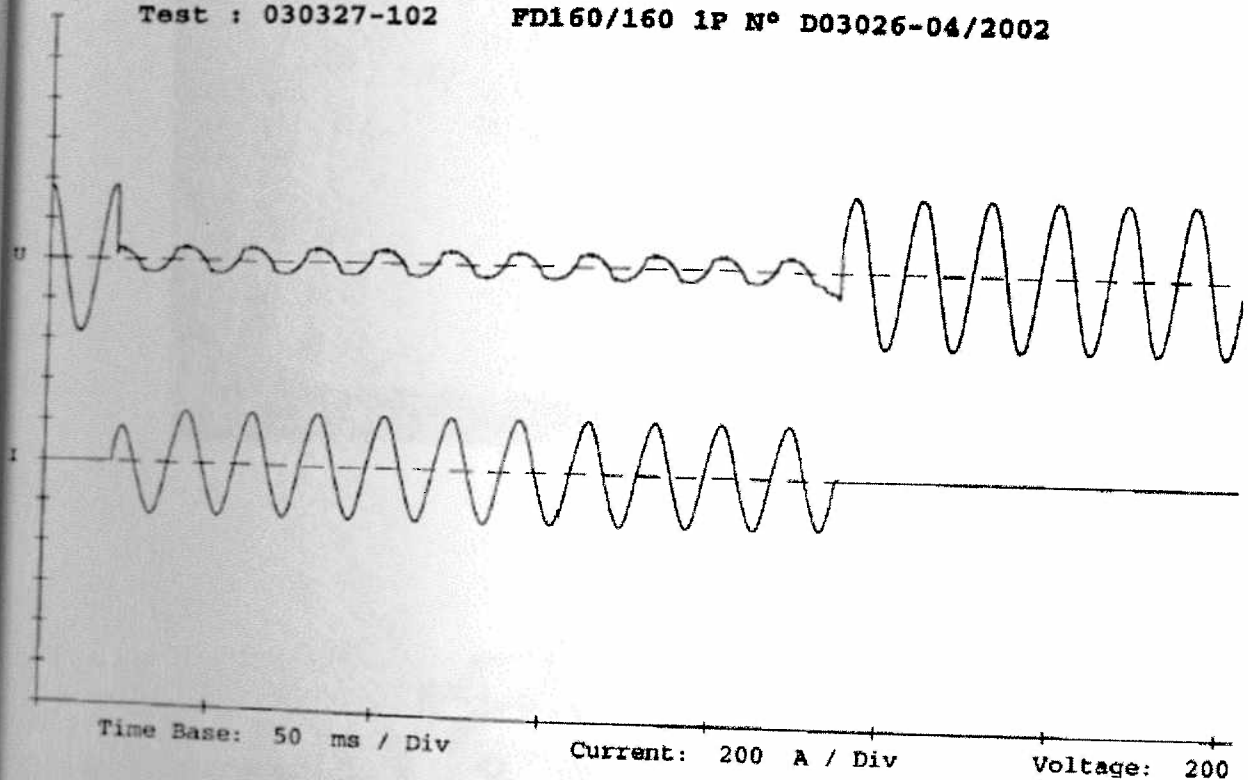
Observations :  
 Result OK



Oscillogram 19: 50<sup>th</sup> CO operational capability sample 04

Apparatus : FD160/160 1P N° D03026-04/2002  
 Test No : 030327-102  
 Type of test : Electrical Operation  
 Commentary : after Ics 25kA/240V  
 50th CO Operation  
 Assigned Voltage : 240 V Test Voltage : 250 V  
 Test Current : 160 A Power Factor : 0.8  
 File : E:\FD160\_1P\030522c\y030521-302

Test : 030327-102 FD160/160 1P N° D03026-04/2002



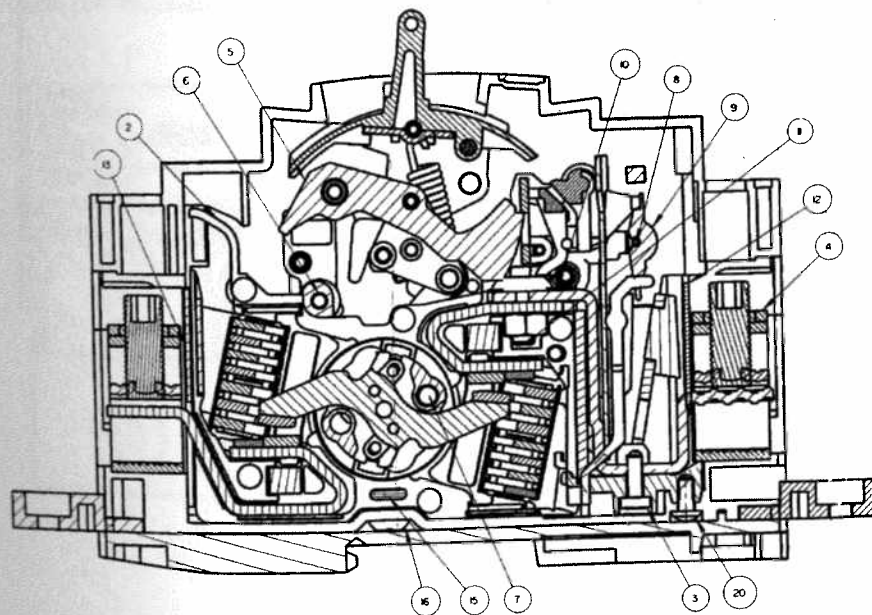
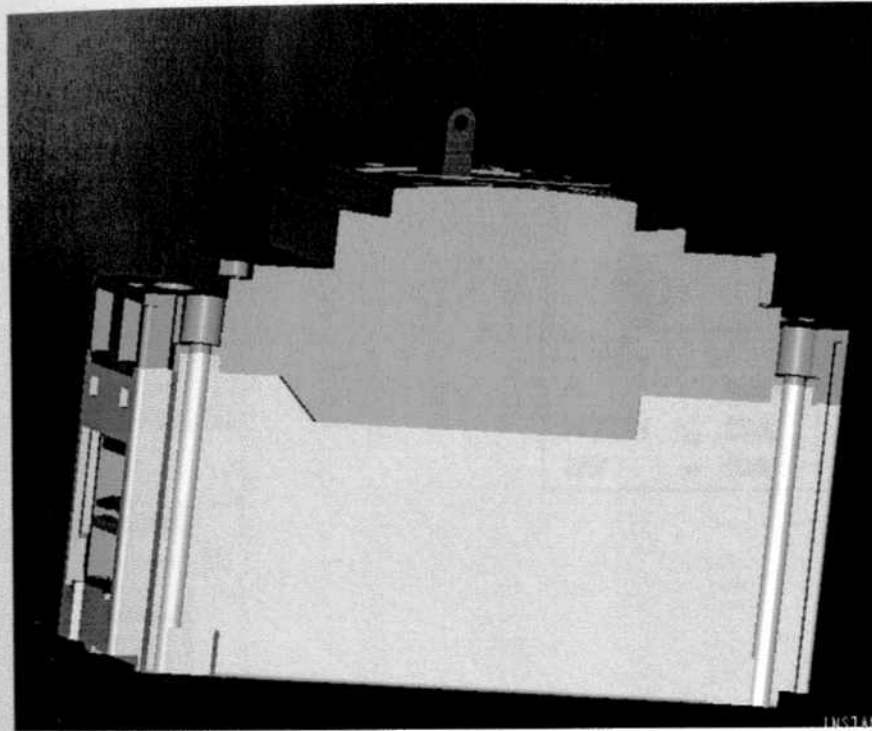
Calculation between: 29.95 ms et 245.75 ms Time 215.8 ms

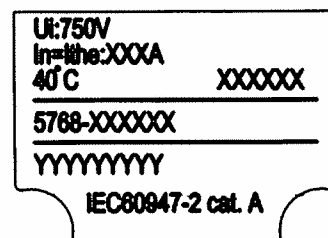
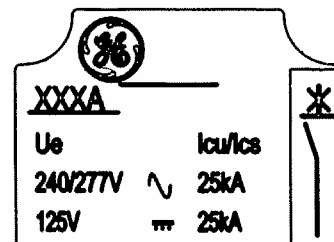
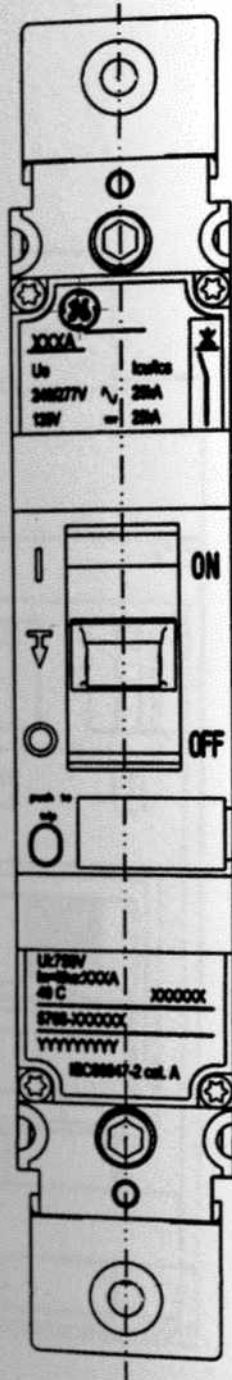
	Phase 1	Units
U Max	131.2	V
I Max	260	A
UI Max	23.9	kVA
SUI dt	1.756	kJ
Si2 dt	6.55	kA's
U recovery	262	V
Ur / U Assigned	109	%
I rms 20 ms	175.6	A rms

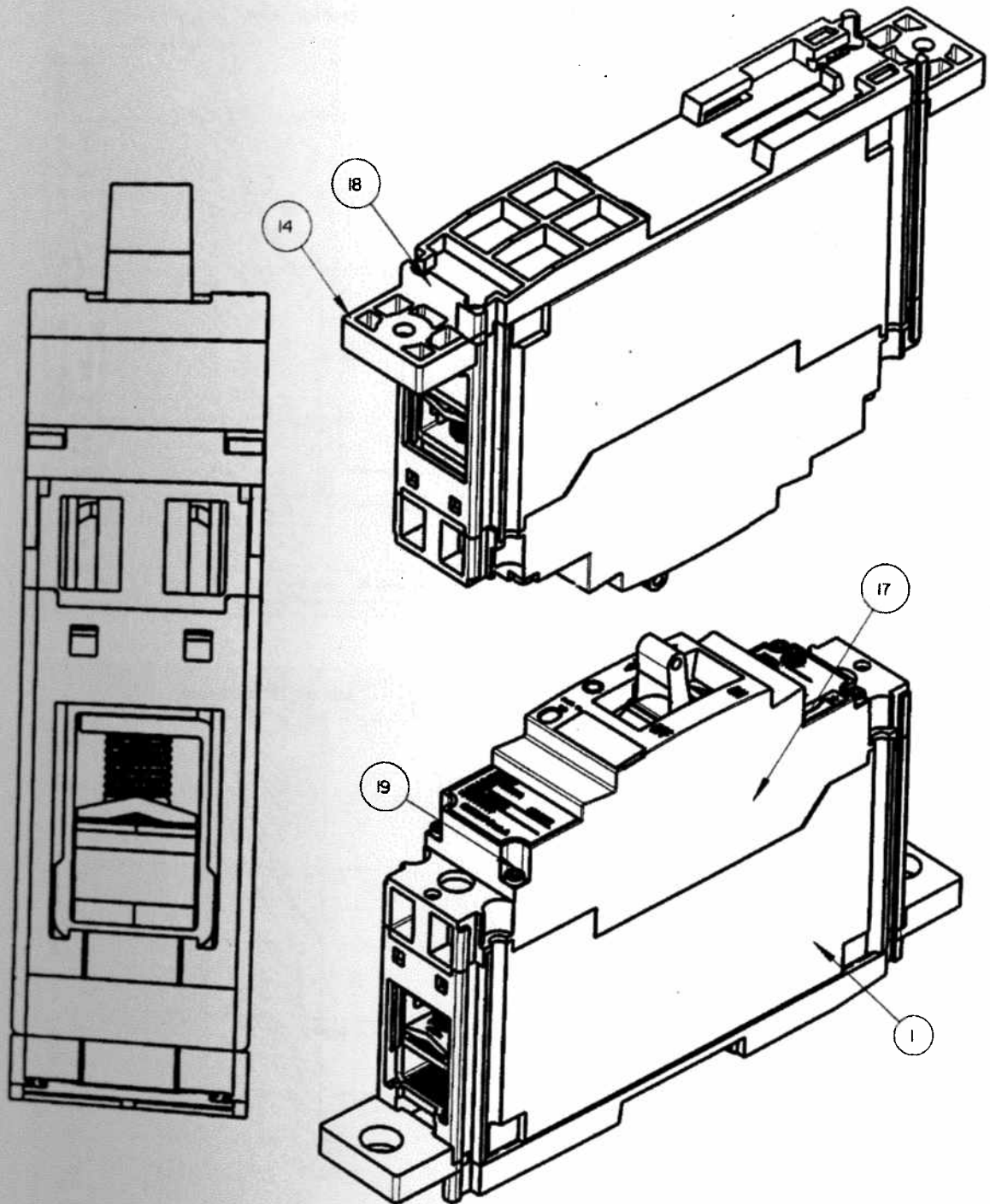
Observations :  
 Result OK



Picture and drawings of the circuitbreaker.







## Tripping curves of the circuitbreaker

